Application Note AN-T-229

Determination of lime salts in sugar beet juices

Reliable and inexpensive complexometric titration methods

The raw sugar obtained from sugar beets and sugar cane plays a major role in the global agricultural industry. About 20% of our sugar comes from sugar beet crops, mostly grown in Europe and the U.S. where the climate is temperate, whereas the other 80% is produced from sugar cane in tropical areas. Lime salts and pH are very important factors which are controlled during the sugar manufacturing process. This Application Note presents a method for determining calcium compounds in sugar beet juice.

To assess the chemical effect of sugar purification, the concentration of lime salts must be determined. Excess lime salts cause issues in this process such as contamination of the heating surface in the evaporator system. Therefore, control of the lime salt concentration in sugar solutions (particularly in the thin and thick juice) is critical. Complexometric titration is often used to determine the concentration of lime salts in these samples. Subjectivity of color change determination is eliminated by using an ion selective electrode (ISE).

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on thin juices with varying lime salt concentrations from different sugar manufacturers.

Sample preparation is not required.

EXPERIMENTAL

The analysis is carried out on a compact Eco Titrator equipped with a combined Ca-ISE electrode, 10 mL cylinder unit, and magnetic stirrer. Before titration, ammonium buffer is added to the sample.

The sample is titrated with EDTA solution until after the equivalence point.

Figure 1. Eco Titrator equipped with a Ca-ISE electrode for the determination of Ca in aqueous solutions.

RESULTS

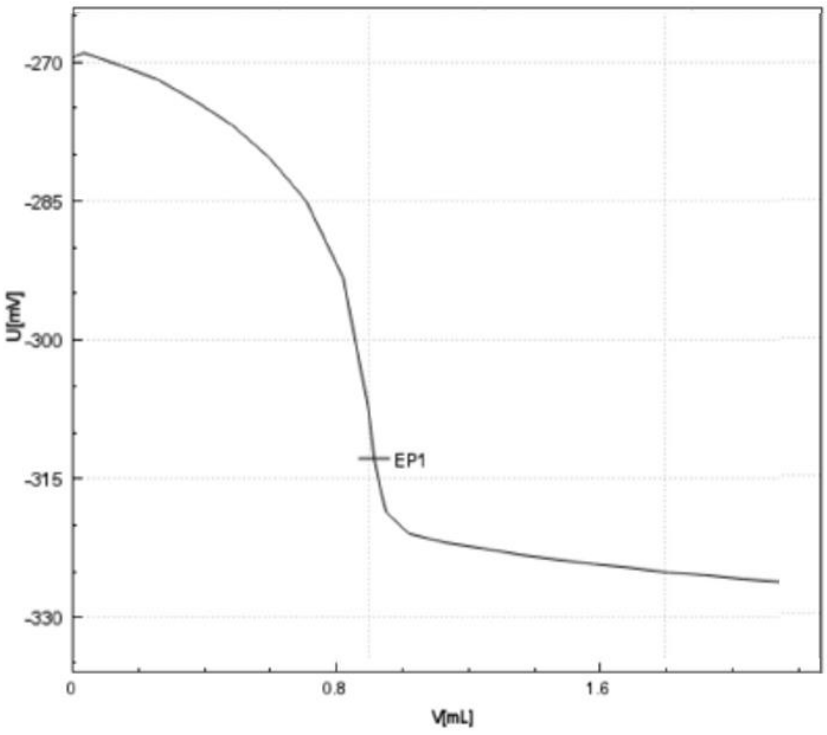

Figure 2. Exemplary titration curve of Sample 1 (Table 1) with EDTA as titrant.

This method offers very reproducible results, as displayed in Table 1.

Table 1. Results of lime salt determination in different sugar beet juices.

Sample (n = 4)	Mean value mg CaO / 100 °Bx	SD(abs) mg CaO / 100 °Bx	SD(rel) in %
1	16.65	0.20	1.2
2	10.49	0.19	1.8
3	17.29	0.19	1.1
4	20.73	0.23	1.1

CONCLUSION

The Eco Titrator makes this analysis easier, more convenient, and more reliable than ever by allowing the analysis to be automated, eliminating any subjective color determination bias. Only a few steps are required to perform the titration and determine the concentration of lime salts in sugar beet juices. The Metrohm Eco Titrator is designed for all standard potentiometric titrations. It is a robust, precise, and affordable piece of laboratory equipment.

CONTACT

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CONFIGURATION

Eco Titrator

The compact Eco Titrator with integrated magnetic stirrer and touch-sensitive User Interface is ideal for routine analysis. It provides GLP-compliant results with minimum space requirements at all times (approx. DIN A4).

Universally compatible with almost all potentiometric titrations, such as, for example, for

- Food products: Acid content, chloride, Vitamin C, iodine and peroxide number in fats
- Water analysis: Carbonate and Ca/Mg hardness, chloride, sulfate, permanganate index
- Petrochemistry: Acid/base number, sulfide & mercaptans, chloride, bromine number
- Electroplating: Total acid, metal content, chloride
- Surfactant analysis: Anionic, cationic and non-ionic surfactants
- Photometry with the Optrode: p and m value, metals, water hardness

Combined polymer membrane electrode, Ca

Combined calcium-selective electrode with polymer membrane.

This ISE is suitable for:

- ion measurements of Ca2+ in aqueous solutions
- complexometric (back) titrations (e.g., determination of water hardness)

Thanks to a robust/break-proof plastic shaft made of propylene and an impact protection for the polymer membrane, this sensor is mechanically very resistant.

The reference electrolyte used is $c(NH_4NO_3)$ = 1 mol/L.